Fact Sheet for Permit Modification for Crow Butte Resources, Inc. (CBR) in Crawford, Nebraska (NE0211670)

IIS: 63416—UIC—NE0211670
Date: March 25, 2015

The Nebraska Department of Environmental Quality (NDEQ) is proposing to issue a major modification to the Underground Injection Control (UIC) Permit Number NE0211670. On February 11, 2015, NDEQ issued an emergency permit (NE0211670 Emergency) for a Class I non-hazardous waste injection well to Crow Butte Resources, Inc. (CBR) in Crawford, Nebraska for Deep Well #1 (DW#1). CBR requested this major modification on March 13, 2015. The emergency permit will expire when this major modification has been completed, or on May 12, 2015, whichever is less. The emergency permit was identical to CBR's existing permit, except it allowed CBR to move the packer up 56 feet until it was adjacent to the Lower Dakota (*see Figure 1*).

This major modification will be similar to the emergency permit issued by NDEQ to CBR. The emergency permit was issued to allow CBR to resume disposal of their wastewater down the injection well which, in turn, allows CBR to continue remediating several of the mine units and continue active mining.

Introduction

The In-situ recovery (ISR) method uses a combination of injection and pumping wells to dissolve the uranium from a formation (a geologic formation is a body of rock identified based on common characteristics). CBR injects some of the wastewater produced by the ISR process down two deep injection wells (DW#1 and DW#2) located on their property. This wastewater is classified as non-hazardous (*see Table 1 for details*) and is currently injected into two formations, the Morrison (casing perforated 3516-3620 ft. below ground*) and the Sundance (casing perforated 3700-3843 ft. below ground). Both the injection mining and the injection of wastewater are activities permitted in the Nebraska Department of Environmental Quality's Underground Injection Control (UIC) program.

The proposed permit is essentially identical to the existing permit for this deep wastewater injection well, with one modification: it will allow CBR to place the packer in the Lower Dakota instead of the Morrison Formation. The packer is a component of the injection well that provides a seal between the outside of the injection tubing and the casing of the injection well (*see Figure 1*). It isolates the injection zone and prevents fluid from moving out of the injection zone in the casing. The Lower Dakota is located directly above the Morrison formation, has very poor quality water, and is separated from the surface by 3388 feet, including approximately 1300 feet of shale (Pierre Shale). Shale's extremely low permeability makes it difficult for fluids, such as groundwater, to move through these formations.

**All measurements from the surface in this document are measured from ground level. All measurements in the permits are measured from the Kelley Bushing on the drilling rig which is 11 or 12 feet above ground level, depending on which drilling rig was utilized.*

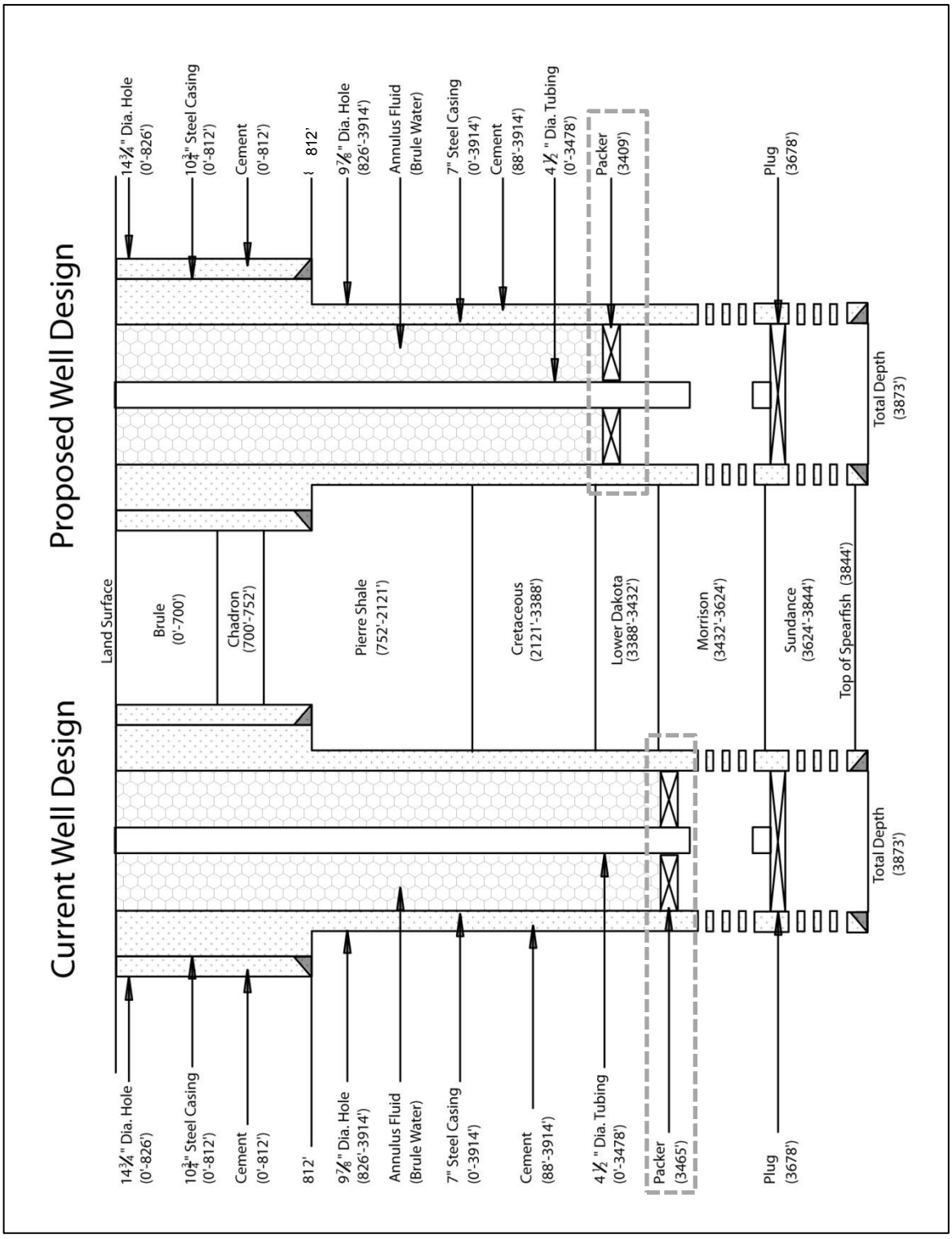

Figure 1. Current and Proposed Well Design for Deep Disposal Well (Same Injection Well)

Overview of the In-Situ Recovery (ISR) Process

ISR is a method to mine uranium ore using injection and pumping wells, rather than open pit or underground mines. Figure 2 shows the ISR extraction process for uranium. ISR involves injecting lixiviant, a solution composed of chemicals (a sodium carbonate/bicarbonate solution and an oxidant, either oxygen or hydrogen peroxide) and groundwater, to oxidize the uranium from the ore body; the uranium-enriched water is pumped out of the mining unit. Monitoring wells are used at ISR uranium mines to monitor for any potential fluid movement from the ISR mining process, termed an excursion. Monitoring wells are placed in any aquifer above or below the mining zone that is used for other industrial or domestic purposes. They are also placed in a ring in the aquifer being mined, around the ore body, to monitor for potential excursions.

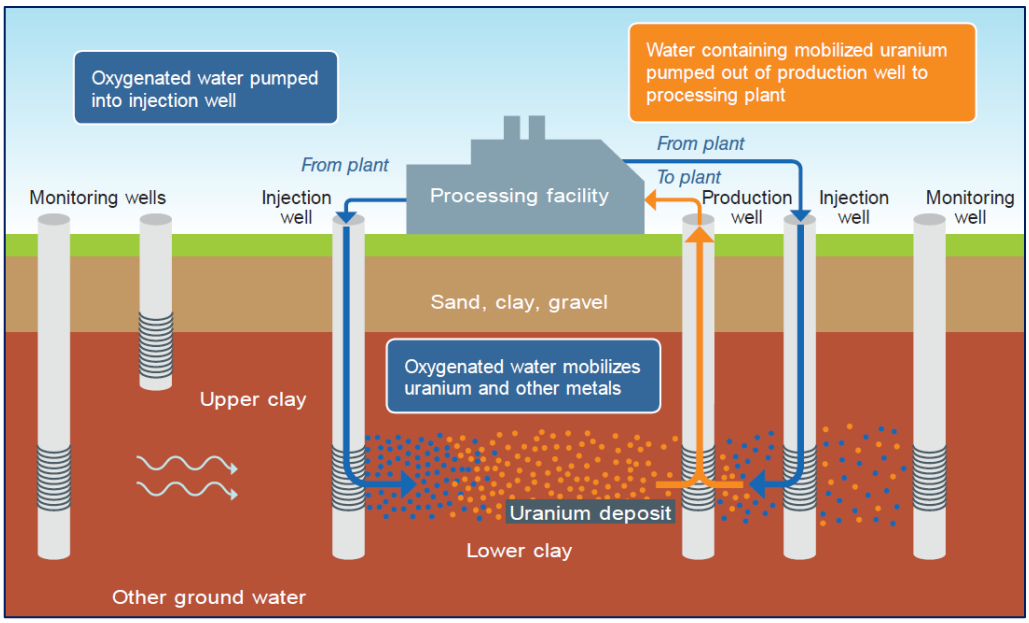

Figure 2. ISR Extraction Process for Uranium (USEPA, 2014).

Deep Injection Well for Wastewater

Wastewater produced by the ISR process is injected by CBR far below any aquifer used for domestic or industrial purposes. The injection zone for CBR's deep wastewater disposal well consists of the Lower Dakota, Morrison, and Sundance and is located at a depth of 3388 ft. to 3498 ft. (*see Figure 1*). However, the current deep injection well is only perforated for injection into the Morrison and Sundance. The deepest aquifer with usable water in this area is located at a depth of 752 ft. The Lower Dakota, Morrison, and Sundance are separated from this aquifer by a series of low permeability rocks, including the Pierre Shale, which has a thickness of 1369 feet (*see Figure 3*).

CBR's deep injection well has one surface casing and one long-string casing. The surface casing is designed to protect the aquifers with usable water from the injection well and extends to a depth of 812 feet from the surface, 60 feet into the top of the Pierre Shale. The long-string casing is used to ensure that the wastewater is injected into the correct formation and is designed to maintain mechanical integrity through the entire length of the well. The

surface and long-string casing are both cemented in place and to the surface. Mechanical integrity means that an injection well does not leak and is able to prevent the movement of fluids into or between aquifers used for drinking water and the injection well wastewater. The long-string casing is currently perforated in the Morrison and Sundance Formations (*see Figure 3*). The only significant modification being made to their permit is to allow them to move the packer up 56 feet until it was adjacent to the Lower Dakota.

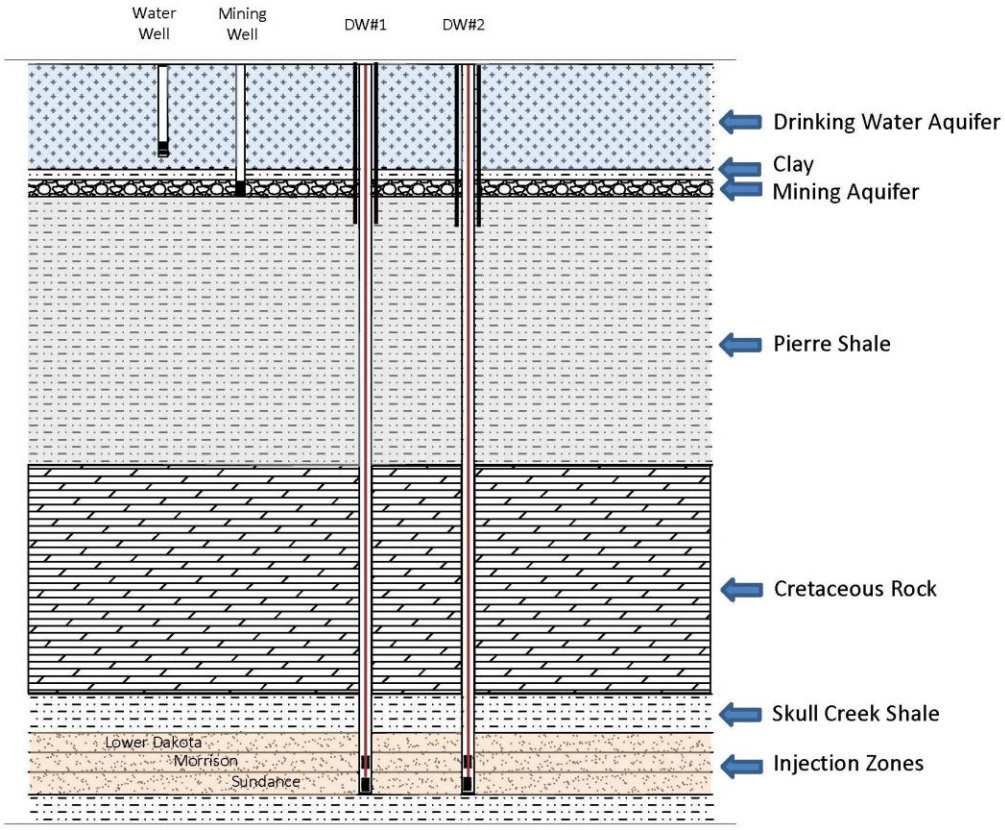

Figure 3. Cross-Section showing Deep Well injection zones.

Series of Events

November 24, 2014

- Annulus Pressure dropped by 73 pounds per square inch (PSI) in the deep disposal well.
- Annulus pressure remained high enough that CBR remained in compliance with their permit.
- CBR shut down the deep disposal well.

November 25, 2014

- Deep disposal well passed a mechanical integrity test.
- Deep disposal well was placed back into service by CBR at reduced capacity until a workover could be completed.

January 12, 2015

- Workover on deep disposal well was started.
- Deep disposal well was taken off-line by CBR.

January 12-February 6, 2015

- CBR conducted a series of tests to determine the reason for the failure and correct the issue that caused the annulus pressure drop.

February 6, 2015

- CBR determined that it is necessary to move the packer higher up in the long-string casing and requested an emergency permit from the Nebraska Department of Environmental Quality.

February 11, 2015

- The NDEQ issued an emergency permit to CBR for 90 days.

March 13, 2015

- CBR requested a major modification to their current permit to allow for the packer to be moved from the Morrison to the Lower Dakota.

Composition of the Injection Stream

The following table contains a composition of the injection stream, as reported by CBR. The average values are calculated from monthly reports from September 2011 through August 2013.

Parameter	Units	Average	Range	Permit Limit
Injection Pressure	psig*	11.5	-10.9-82.0	650
Alkalinity	mg/l**	1749	1400-2300	4,100
Arsenic	mg/l**	<0.1	<0.1	5
Barium	mg/l**	<0.1	<0.1	100
Cadmium	mg/l**	<0.1	<0.1	1
Chloride	mg/l**	2692	567-8243	40,000
Chromium	mg/l**	<0.5	<0.5	5
Lead	mg/l**	<0.5	<0.5	5
Mercury	mg/l**	<0.0001	<0.0001	0.2
pH	Std. Units***	8.18	7.83-8.51	5.0 – 9.5
Radium 226	pC/l****	947	469-1520	5,000
Selenium	mg/l**	<0.1	<0.1	1
Silver	mg/l**	<0.5	<0.5	5
Sodium	mg/l**	2785	1334-6506	40,000
Sulfate	mg/l**	1393	933-1930	10,000
Uranium (U_3O_8)	mg/l**	4.7	2-9	25
Vanadium mg/l** 6.5		1-8.9	50	

* pounds per square inch gage (psig)
** mIligram/liter (mg/l)
*** pH is based on the logarithmic scale and is a unit of measure (Std. Units)
**** picocoulomb/liter (pC/l)

Table 1.Composition of the Injection Stream (September 2011-August 2013)

The proposed permit will include the same injection limitations and specific monitoring requirements for the parameters listed above as CBR's current permit for the deep disposal well. No changes in injection rates, parameter limits, or monitoring requirements are proposed for this permit modification.

Information

The proposed permit modification and supporting materials are available for inspection at the office of the Nebraska Department of Environmental Quality, Suite 400, 1200 "N" Street, Lincoln, Nebraska 68509 and at http://deq.ne.gov. Inquiries may be made at (402) 471-2186 or nancy.harris@nebraska.gov . Individuals requiring special accommodations or alternate formats of materials should notify the Department by calling (402) 471-2186. TDD users should call (800) 833-7352 and ask the relay operator to call the Department at (402) 471-2186.

Persons may comment upon or object to the proposed permit modification or may request a public hearing by writing to Jim Macy, Director, Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, Nebraska, 68509-8922, prior to **May 5, 2014**. A request for public hearing shall state the nature of the issues proposed to be raised at a hearing. NDEQ, prior to making a decision regarding a public hearing shall consider all comments. If NDEQ receives substantive comments regarding this modification, a public hearing may be scheduled.
